(No Model.) 2 Sheets—Sheet 1.

R. W. GARDNER.

GOVERNOR.

No. 287,822. Patented Nov. 6, 1883.

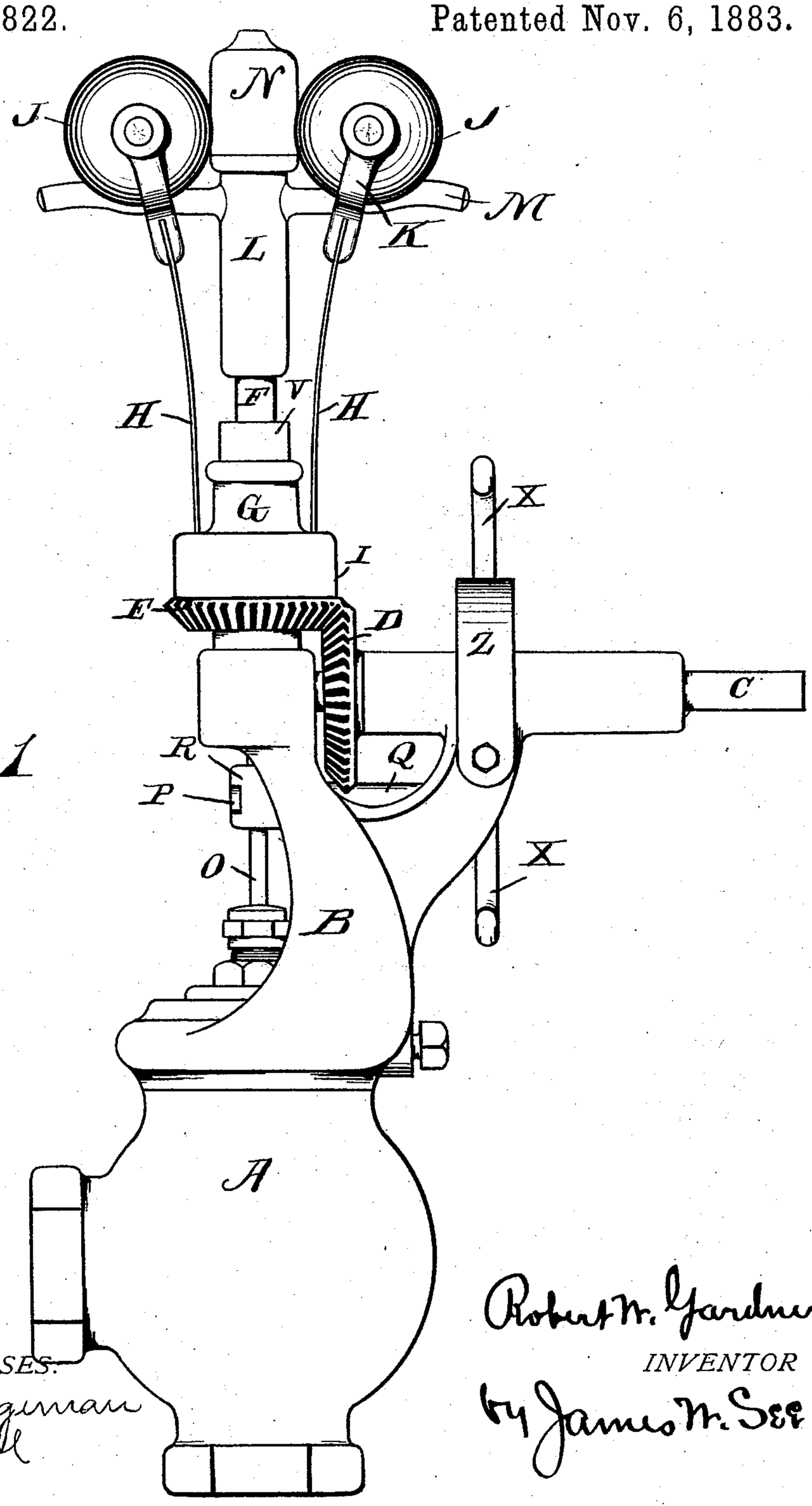

Fig 1

WITNESSES:
Geo Tangeman
J. W. Cornell

Robert W. Gardner
INVENTOR
by James M. See
ATTORNEY

(No Model.) 2 Sheets—Sheet 2.

R. W. GARDNER.

GOVERNOR.

No. 287,822. Patented Nov. 6, 1883.

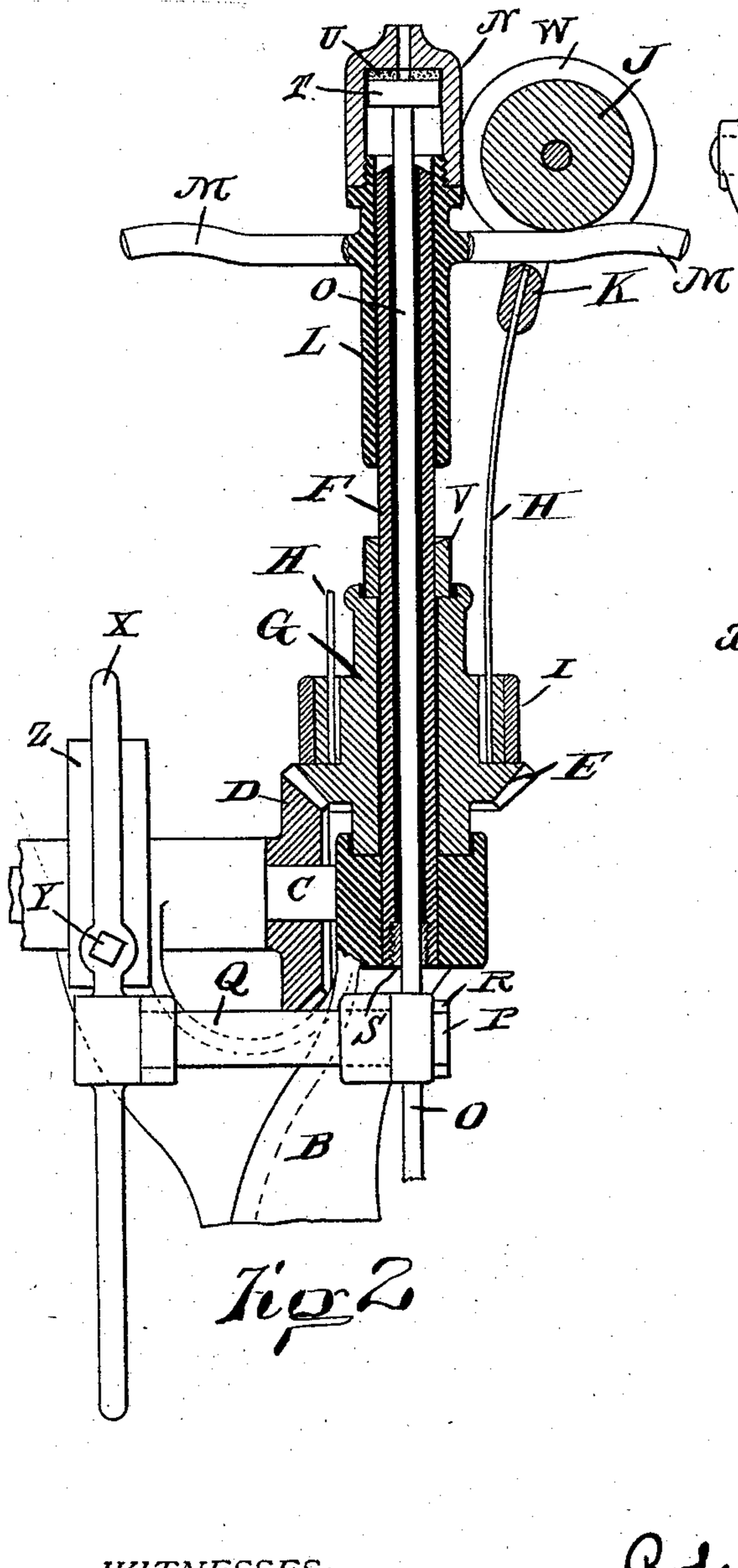

Fig 2

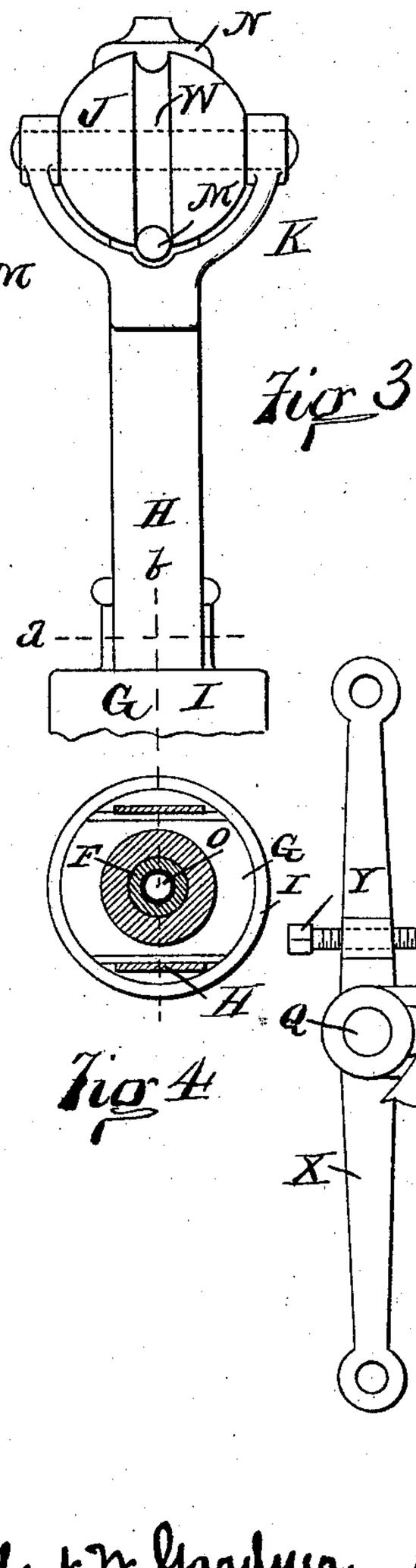

Fig 3

Fig 4

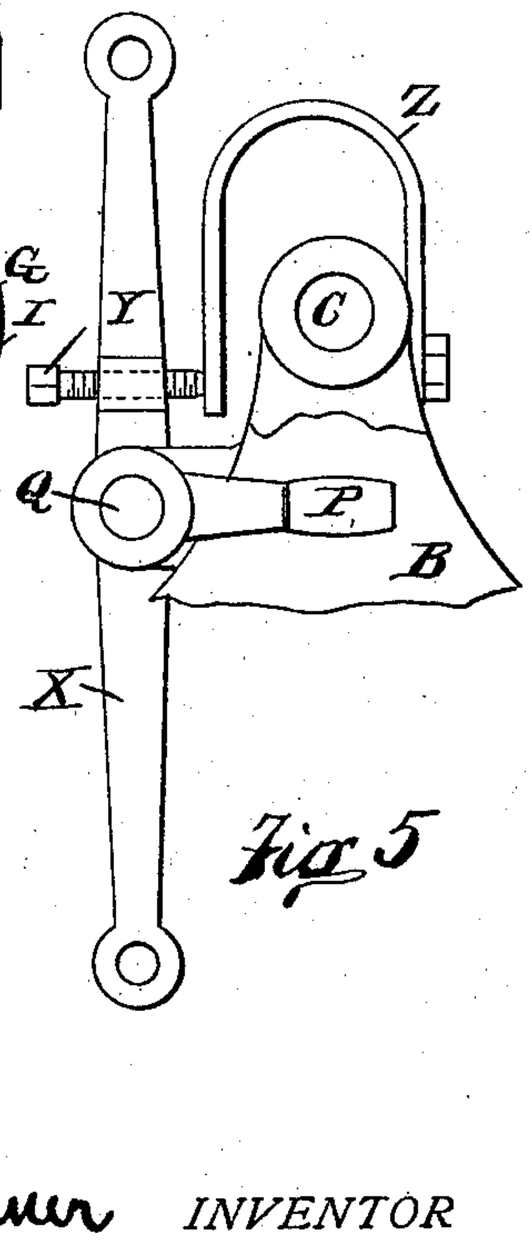

Fig 5

WITNESSES:
Geo Tangeman
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Robert W. Gardner INVENTOR
by James W. See
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UNITED STATES PATENT OFFICE.

ROBERT W. GARDNER, OF QUINCY, ILLINOIS, ASSIGNOR TO THE GARDNER GOVERNOR COMPANY, OF SAME PLACE.

GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 287,822, dated November 6, 1883.

Application filed August 22, 1883. (No model.)

To all whom it may concern:

Be it known that I, ROBERT W. GARDNER, of Quincy, Adams county, Illinois, have invented certain new and useful Improvements in Governors, of which the following is a specification.

This invention relates to centrifugal governors for steam-engines, &c.

The invention will be understood from the following description, in connection with the accompanying drawings, in which—

Figure 1 is a front elevation of a governor embodying my improvements; Fig. 2, a sectional front view of the upper portion of the same on line *b;* Fig. 3, a side elevation of upper part; Fig. 4, a sectional plan on line 2; and Fig. 5, a side elevation, viewed from a position to the left of Fig. 1, of a portion of the governor exhibiting the construction of the speeder.

In the drawings, A represents the governor-valve body; B a housing secured thereto, to sustain the moving parts; C, the pulley-shaft of the governor; D, a bevel-gear on said shaft; E, a bevel-gear driven thereby, F, a stiff tube with its lower end rigidly secured in the housing in line with the axis of the governor-valve; G, a hub fitted to revolve on said tube, and having a step-bearing around the tube upon the top of the housing, and having formed with it the bevel-gear E; H H, flat springs projecting upward from hub G, and having their lower ends secured rigidly therein; I, a collar surrounding hub G, and serving as a means for securing the springs H to the hub; J J, spherical weights attached to the upper ends of springs H; K K, forks secured to the upper end of springs H, and sustaining pins on which the weights are free to revolve; L, a top sleeve fitted to revolve and rise and fall upon the upper end of the tube F; M M, a pair of arms formed with sleeve L and projecting radially therefrom under and in a position to support the weights J; N, a top cap screwed upon sleeve L; O, a stem from the governor-valve reaching upward through tube F to cap N; P, a forked lever engaging the valve-stem O; Q, a shaft mounted in bearings alongside shaft C, and carrying at one end the forked lever P; R, a collar fixed to the valve-stem, and serving as means by which the forked lever engages the valve-stem; S, a bushing in lower end of tube F, fitting fairly upon the stem O, which is smaller than the bore of the tube; T, a head secured to the upper end of stem O within the cap N; U, a lubricating thrust-disk, of rawhide or similar material, interposed between the roof of the cap and the top surface of head T; V, a collar fast on tube F above hub G, to prevent the rising of the hub upon the tube; W W, peripheral grooves in weights J engaging arms M; X, a double-ended lever on outer end of shaft Q; Y, a set-screw through lever X above its axis, and pointing toward shaft C; and Z, a flat spring bolted to the bearing of shaft C and bent over said bearing, so as to present its free end in front of set-screw Y.

The hub G in its rotation carries with it the springs and weights and the armed sleeve L. The strain of the springs urges the weights inward. Centrifugal force urges them outward. The parts of the weights as they move inward and outward may be described as arcs modified by a radius of changing length. The arms M, instead of being curved to conform to the natural path of the weights, are curved, speaking in a general way, into arcs of greater radius. As a consequence, the weights in moving outward pull the sleeve downward, and thus push the stem O downward and effect a certain closure of the valve.

The tendency of spring Z, acting through levers X and P, is to lift the stem and the sleeve and keep the arms M close in contact with the weights. The weights, as they travel, roll along the arms with little or no frictional resistance.

The double-ended lever X is for service when the governor-valve is to be used as a sawyer's cut-off.

The distance to be moved by the weights in effecting the full valve movement having been determined, the governor is arranged to run at such speed about as will maintain the weights in a position corresponding to half their outward movement; or, the speed having been fixed upon, the strength of the springs H is modified to produce the same effect. Adjusting the set-screw Y changes the resistance of the valve to a downward motion, and thus increases the resistance to the action of the gov-

ernor-weights; but at the same time this adjustment does not act with full effect in adding to or lessening the centripetal force of the weights. The device may be likened to a fixed nut and rotary screw, in which rotation of the screw results in rectilinear motion of the screw; but rectilinear motion imparted to the screw has little or no effect in producing rotation of the screw. The effect of the adjustment at Y, which forms the speeder of this governor, is to alter the effect of the governor without materially altering its forces of action.

The curve of the arms M has been referred to as being such as to cause a vertical movement of the sleeve as the weights move. Further than this, the curve is a variable one, as shown, whereby a given degree of travel of weight near the outer extremity of its stroke will produce more vertical motion in the sleeve, &c., than the same degree of weight travel will produce when further inward. The weights thus become more effective as they move outward, and by proper regulation of the curve of the arms the governor can be rendered nearly isochronous. Furthermore, the curvature of the arms may be modified so as to produce any desired reasonable proportion of weight travel to valve travel.

In practice I make the sleeve, with its arms, of malleable cast-iron, and I turn and finish the arms with no curvature. By means of suitable bending and forming dies I then give to the arms the desired curvature, and this curvature I can modify at any time by bending, so as to adapt the governor to peculiarities of individual engine conditions.

I do not confine myself to arms formed integral with the sleeve, as they may be separably or permanently secured to it if made of separate pieces.

I do not confine myself to malleable arms, as they may be of cast-iron formed to proper curvature by cutting processes.

I do not confine myself to the given arrangement of speeder-spring and lever, as the spring may be arranged to act with an adjustable pressure to lift the stem when otherwise arranged, and for permanent speeds no adjustment of the upward tendency of the valve-stem is needed, and a weight adjustable or not in its effect may take the place of the spring arrangement.

Instead of the springs H serving at once as centripetal elements and radius-bars, I contemplate the possible employment of linked radius-bars with centripetal springs to draw the weights inward. In case the arms were made straight instead of curved, and the periphery of the weights, where they roll on the arms, made in cam form instead of circular, the travel of the weights would cause the arms to rise and fall, and would be equivalent to the curved arms in combination with circular weights.

Let it be noticed the stem O may be attached to the sleeve so as to both rise and fall with it without the aid of the speeder-spring. This spring may be omitted entirely if an adjustable speeder is not needed.

The method of driving the governor by driving the hub G, and transmitting the motion thence through the springs to the sleeve, which is free to revolve and slide upon the tube, is not at all essential. The sleeve may obviously be the driven element, and the hub may be the rising and falling element.

There are many well-known forms of mechanism applied to governor construction to transmit a vertical motion to the governor-valve, and I contemplate the utilization of any such found suitable in connection with the new features of my invention.

I claim as of my invention the following improvements in governors:

1. The rolling weights, the springs H, or equivalent means for urging the weights inward and preventing their vertical displacement, and the sleeve with its curved arms, combined substantially as and for the purpose set forth.

2. The rolling weights, the springs H, or equivalent means for urging the weights inward and preventing their vertical displacement, and the sleeve with its variably-curved arms, combined substantially as and for the purpose set forth.

3. The rolling weights, the springs H, or equivalent means for urging the weights inward and preventing their vertical displacement, and the integrally-formed sleeve and arms of malleable iron, combined substantially as and for the purpose set forth.

4. The rolling weights, the springs H, or equivalent means for urging the weights inward and preventing their vertical displacement, the sleeve with its arms, and the adjustable speeder-spring or its equivalent arranged to resist the vertical movement of the sleeve, combined substantially as and for the purpose set forth.

5. The shaft Q, the levers X and P, and the bent spring Z, combined substantially as and for the purpose set forth.

ROBERT W. GARDNER.

Witnesses:
HENRY L. PORTER,
L. C. NEUSTADT.